PLANNING OF EIGHT FLOORS PARKING STRUCTURE WITH INTERMEDIATE MOMENT RESISTING FRAME (IMRF) IN SURAKARTA

Final Project

Final Project to Achieve a Part of
Civil Engineering Bachelor Degree Requirement

Submitted by :

ASSO' ADHI SUTRISNO
D 100 122 005

CIVIL ENGINEERING DEPARTMENT
ENGINEERING FACULTY
MUHAMMADIYAH UNIVERSITY OF SURAKARTA
2019

CERTIFICATION SHEET

PLANNING OF EIGHT FLOORS PARKING STRUCTURE WITH INTERMEDIATE MOMENT RESISTING FRAME (IMRF) IN SURAKARTA

Final Project

Submitted and maintain in final project exam
In the presence of the examiners
At date, May 17 , 2019

Submitted by :

ASSO' ADHI SUTRISNO
D100 122 005

Composition of examiners lecturer

Supervisor

Budi Setiawan, S.T., M.T.
NIK: 785

Examiner I

Muhammad Ujianto, Ir., S.T., M.T.
NIK: 728

Examiner II

Yenny Nurchasanah, S.T., M.T.
NIK: 921

This final project is accepted as a requirement of
Acheaving S-1 graduate degree of Civil Engineering
Surakarta, May 17 , 2019

Dean of Engineering Faculty

Ir. Sri Sunarjono, M.T., PhD.
NIK: 733

Chairman of Civil Engineering Department

Mochamad Solikin, S.T., M.T., PhD.
NIK: 792

DECLARATION OF AUTHORSHIP

I am as the author declare that, this final project is prepare and presented by myself, except the quotation and summaries that I have explained from all of the sources and put on the references.

If later is found that this Final Project is a plagiarism product, then I will accept any legal consequences that may be imposed to me

Surakarta, May 17, 2019

Author

ASSO' ADHI SUTRISNO

D 100 122 005

AL QURAN TELLS STORIES ABOUT BUILDING

He said, "O my Lord! Forgive me, and grant me a kingdom which, (it may be), suits not another after me: for Thou art the Grantor of Bounties (without measure).Then We subjected the wind to his power, to flow gently to his order, Whithersoever he willed,As also the evil ones, (including) every kind of builder and diver. (Q.S. Saad: 35-37)

They worked for him as he desired, (making) arches, images, basons as large as reservoirs, and (cooking) cauldrons fixed (in their places): "Work ye, sons of David, with thanks! but few of My servants are grateful!"(Q.S. Saba': 13)

[Solomon] said, "O assembly [of jinn], which of you will bring me her throne before they come to me in submission". A powerful one from among the jinn said, "I will bring it to you before you rise from your place, and indeed, I am for this [task] strong and trustworthy. "Said one who had knowledge from the Scripture, "I will bring it to you before your glance returns to you. "And when [Solomon] saw it placed before him, he said, "This is from the favor of my Lord to test me whether I will be grateful or ungrateful. And whoever is grateful - his gratitude is only for [the benefit of] himself. And whoever is ungrateful - then indeed, my Lord is Free of need and Generous."(Q.S. Naml: 38-40)

She was asked to enter the lofty Palace: but when she saw it, she thought it was a lake of water, and she (tucked up her skirts), uncovering her legs. He said: "This is but a palace paved smooth with slabs of glass." She said: "O my Lord! I have indeed wronged my soul: I do (now) submit (in Islam), with Solomon, to the Lord of the Worlds."(Q.S. Naml: 44)

DEDICATION FOR

- For my beloved family, Father, Mother, Brother and Sister. Thank you for all the prayers, guidance, valuable lessons, and affection that has been bestowed upon me and has given spirit until the completion of this Final Project
- Large families in Grobogan and second home in MALIMPA, thanks for their prayers and support.
- *Jazakallohu khoiron khatsiro* thanks for all the prayers, encouragement, motivation, spirit, love and everything you give. Hopefully this knowledge that we have learned to be a blessing and beneficial for Muslims and a blessing of the Worlds.

PREFACE

بِسْمِ اللهِ الرَّحْمٰنِ الرَّحِيْمِ

Assalamu'alaikum Warahmatullohi Wabarokatuh.

Praise gratitude we pray to Allah Subhanahu wataa'la, thanks to the abundance of grace, Taufik and his guidance we were able to complete the preparation of this Final easily and smoothly. Solawat and greetings remain devoted to the Messenger Muhammad solaullohu alaihi wa salam. This final project with title **"Planning of Eight Floors Parking Structure With Intermediate Moment Resisting Frames (IMRF) In Surakarta"** prepared to complete the requirements for completing the study program S-1 at the Department of Civil Engineering, Faculty of Engineering, Muhammadiyah University of Surakarta. Together these authors would like to thank all those who have provided support, so the compiler can resolve this Final and gain knowledge as stock later

With the completion of this final project authors say many many thanks especially to:

1). Mr. Ir. Sri Sunarjono, M.T., PhD. as Dean of the Faculty of Engineering, Muhammadiyah University of Surakarta.
2). Mr Mochamad Solikin, S.T., M.T., PhD. as Chairman of Civil Engineering, Muhammadiyah University of Surakarta.
3). Mr. Budi Setiawan, S.T., M.T. as Supervisor Final project as well as the Chairman of the Board of Examiners who have provided motivation, direction and guidance.
5). Mr. Muhammad Ujianto, Ir., S.T., M.T. and Mrs. Yenny Nurchasanah, S.T., M.T. As examiners final project, which has provided motivation, direction and guidance
3). Mr. Anto Budi L, ST, MSc. as Academic Advisors who have provided motivation and advice to always passion to finish this Final.

6). Fathers and mothers lecturer of the Department of Civil Engineering, Muhammadiyah University of Surakarta thanks for the guidance and knowledge that has been taught to us.

7). Beloved extended family, thank you for the prayers and affection that has been given so far, may Allah subhanahu wataa'la gathered us in paradise soon. Ameen.

8). All those who have helped in completing this final report.

The author, aware that the preparation of the final report is still far from perfect, because the criticism and constructive suggestions are expected and hopefully this report is useful for us all.Ameen.

Wassalamu'alaikum Warahmatullohi Wabarokatuh.

Surakarta, May , 2019

Redactor

TABLE OF CONTENTS

Page

TABLE

Page

FIGURE

Page

ATTACHMENT

NOTATION

A_{cp} = The area bounded by the edge of the cross-sectional area (including hole), mm^2.

A_0 = The extent bounded by the central line wall pipe, mm^2.

A_{0h} = Restricted area begel outermost line, mm^2.

A_s = Area of longitudinal reinforcement tension (beam), mm^2.

= Area main reinforcement (slabs), mm^2.

A'_s = Area of longitudinal reinforcement compression (beam), mm^2.

A_{sb} = Divided reinforcement area (slabs), mm^2.

A_{st} = $A_s + A'_s$ = Total area of longitudinal reinforcement (beam), mm^2.

$A_{s,b}$ = Tension reinforcement area on balanced condition (*balance*), mm^2.

$A_{s,maks}$ = The maximum limit area tension reinforcement on the concrete, mm^2.

$A_{s,min}$ = The minimum limit area tension reinforcement on the concrete, mm^2.

$A_{s,u}$ = Area of reinforcement necessary, mm^2.

$A_{v,u}$ = Area of shear reinforcement necessary, mm^2.

a = High block stress compression equivalent square block compression, mm.

a_b = High block stress compression equivalent square block compression condition balance, mm.

b = Wide beam, mm.

C_d = Deflection amplification factor

C_u = The upper limit coefficient of the period of vibration of the structure

C_c = Compression force concrete, N.

C_i = Coefficient of the slabs moment in the direction of the direction -i.

C_{lx} = Coefficient of plate field moment in the direction of the direction-x (short span).

C_{ly} = Coefficient of plate field moment in the direction of the y-direction (long span).

C_{tx} = Coefficient of plate field moment in the direction of the x-direction (short span).

C_{ty} = Coefficient of plate field moment in the direction of the y-direction (long span).

C_{rs} = Risk coefficient mapped short acceleration response period

C_{r1} = Risk coefficient mapped long term acceleration response

D = Dead load, N, N/mm, or Nmm.

= Symbol of reinforcement *deform* (threaded rebars).

d = The distance between the center of the tension reinforcement and the edge of the concrete compression fiber, mm.

d_b = Reinforcement diameter, mm.

d_d = The distance between the center of tensile reinforcement on the innermost row and the ege fiber concrete compression, mm.

d'_d = The distance between the center of compression reinforcement on the innermost row and the ege fiber concrete compression, mm.

d_s = The distance between the center of the tension reinforcement and the concrete edge of the tension fiber, mm.

d_{s1} = The distance between the center of the first tension reinforcement weight and the edge of the concrete fiber tension, mm.

d_{s2} = The distance between the center of the first and second line tension reinforcement weights, mm.

d'_s = The distance between the center of the reinforcement compression and the edge of the concrete fiber compression, mm.

E = The load caused by the earthquake (*eartquake load*), N or Nmm.

E_c = Modulus of elasticity of concrete, MPa.

E_s = Modulus of elasticity of stell, MPa.

f_{ct} = Concrete tension strength, MPa.

f'_c = Compressive strength of concrete and concrete quality required on concrete age 28 day, MPa.

F_a = Coefficient of acceleration site short period.

F_v = Site acceleration coefficient of 1 second.

f_y = Longitudinal reinforcement yield strength steel, MPa.

f_{yt} = Transverse reinforcement steel yield strength, MPa.

h = Height cross section of the structure, mm.

I = Moment of inertia, mm^4.

K = Factor moment, MPa.

K_{max} = Maximum moment factor, MPa.

L = Live load (*life load*), N, N/mm, or Nmm.

M_i = Moment plate in the direction of the direction -I, Nmm.

M_n = Actual nominal moment of structure, Nmm.

$M_{n,max}$ = Maximum nominal moment of maximum structure, Nmm

M_{lx} = Moment middle of plates in the direction of the direction -x (short span), Nmm.

M_{ly} = Moment middle of plates in the direction of the direction -y (long span), Nmm.

M_{tx} = Moment middle of plates in the direction of the direction -x (short span), Nmm.

M_{ty} = Moment middle of plates in the direction of the direction -y (long span), Nmm.

M_U = Necessary moments or moments factor, Nmm.

M_r = Moment of the structure plan, Nmm.

m = Maximum number of reinforcements 1 line beam wide.

N = Standard penetration test

n = The total number of reinforcement bars on the beam count.
= The number of feet shear reinforcement on the count shear reinforcement.

P_{cp} = Circumference bounded by the edge of the cross-sectional area (including hole), mm.

P_h = The circumference of which is bounded by the outermost line of the outer layer, mm.

q_D = Dead load distribution, N/mm.

q_L = Live load distribution, N/mm.

q_u = Load factor distribution, N/mm.

r = Inertial radius, mm.

S_{DS} = Short period acceleration response parameters

S_{D1} = Acceleration response parameter of 1 second period

S = Distance 1 meter or 1000 mm.

s = space shear reinforcement or space slabs reinforcement, mm.

T_n = Moment torque n nominal, Nmm.

T_u = Moment torque necessary or torsion torque, Nmm.

U = Strength necessary or load factor, N, N/mm, or Nmm.

V_c = shear forces that can be retained by concrete, N.

V_n = nominal shear forces in reinforcement concrete structures, N.

V_s = shear forces that can be retained by the reinforcement, N.

V_u = necessary shear force or shear force force, N.

V_{ud} = the shear force at the distance d from the face of the pedestal, N.

α = the location of the reinforcement.

β = reinforcement coating factor.

β_1 = the equivalent square type stress concrete factor depending on the quality of the concrete.

γ = reinforcement factor.

γ_c = Specific gravity concrete, kN/m^3.

γ_t = Weight soil on the foundation, kN/m^3.

λ = lightweight aggregate load factor.

= long span, m.

λ_d = length of tensile or tensile stress distribution, mm.

λ_{db} = length of basic stress distribution, mm.

λ_{dh} = length of hook reinforcement, mm.

λ_{hb} = length of hook distribution base, mm.

λ_n = clean span of columns or beams, m.

ϕ = symbol of plain reinforcement dimension, mm.

= strength reduction factor.

ρ = redundancy factor

Ω_0 = Stronger factor over structure

δ = Drift story

PLANNING OF EIGHT FLOORS PARKING STRUCTURE WITH INTERMEDIATE MOMENT RESISTING FRAME (IMRF) IN SURAKARTA

Abstrak

Kemacetan adalah situasi atau keadaan yang tersendat atau gangguan lalu lintas yang disebabkan oleh banyaknya kendaraan yang melebihi kapasitas jalan. Kemacetan terjadi di kota-kota besar, seperti Surakarta, yang merupakan salah satu kota besar di Jawa, terutama di daerah Beteng sebagai pusat perdagangan. Ada banyak kendaraan di tempat parkir yang tidak memadai, sehingga tempat parkir dialihkan di jalan. Ini menjadi masalah ketika Kereta Batara Kresna lewat. Maka, untuk mengembalikan jalan ke fungsinya di kawasan Beteng, direncanakan dibangun parkir delapan lantai dengan metode Sistem Rangka Pemikul Momen Menengah (SRPMM). Ada beberapa hal yang harus dipertimbangkan dalam perencanaan struktur bangunan termasuk aspek kualitas, arsitektur, ekonomi, dan keamanan. Perencanaan bangunan parkir mengacu pada Pedoman Teknis Penyelenggaraan Fasilitas Parkir (DRJD 1996), Standar Nasional Indonesia (SNI), yaitu SNI-2847:2013 (Persyaratan untuk Struktur Bangunan Beton) dan SNI-1726:2002 (Prosedur Perencanaan Ketahanan Gempa untuk Struktur Bangunan dan Non-Bangunan). Perencanaan bangunan meliputi struktur utama (struktur kolom, balok, dan stuktur dasar), struktur atap dan struktur pelat (pelat atap, pelat lantai, pelat lantai dasar dan tangga). Lokasi lahan rmasuk kategori klasifikasi SD (tanah sedang),dengan nilai SDS diperoleh 0,602g dan SD1 diperoleh 0,372g, faktor modifikasi respons (R) 5, metode analisis beban gempa menggunakan statik equivalen. Kualitas beton yang digunakan f_c' 30 MPa, dan kualitas tulangan baja polos f_y 240 MPa dan tulangan ulir f_y 400 MPa. Ketebalan pelat lantai adalah 15 cm dari lantai 1 hingga lantai 7, 12 cm untuk atap, dan 20 cm untuk lantai dasar. Dimensi awal struktur balok dan ramp adalah 600/300 dan dimensi awal balok anak adalah 500/250 mm. Sedangkan untuk dimensi awal kolom adalah 800/800 mm. struktur dasar direncanakan memakai pondasi tiang pancang dengan kedalaman 9 m.

Kata Kunci: perencanaan gedung, sistem rangka pemikul momen menengah, struktur parkir.

Abstract

Congestion is a situation or circumstance stagnated or even interruption of traffic caused by the large number of vehicles exceeding the capacity of the road. Congestion happens in the big cities, belongs to Surakarta, which is one of the big city in Java, especially in Beteng area as a trading center. There are many vehicles in the parking lot that were not sufficient, so the parking lot is diverted on the street. It becomes a problem when the Batara Kresna Train passes. So, to return the road to its function in the Beteng area planned building parking eight floors with Intermediate Moment Resisting Frame (IMRF) method. There are some things that should be considered in planning a building structure including quality aspects, architectural, economic and safety. The planning parking building refers to the Technical guidelines for organizing parking facilities (DRJD 1996), Indonesian regulatory standards (SNI), is in SNI-2847:2013 (Requirements for Structural Concrete Building) and SNI-1726:2002 (Earthquake Resilience Planning Procedures for Building Structures and Non-Building). The building plan includes

the main structure (beam, column, and base structure), roof structure and slabs structure (roof slab, floor slab, base slab and stair). The land sites including category classification SD (soil medium), then the SDS values obtained are 0,602g and SD1 obtained are 0,372g, response modification factor (R) 5, the method of analysis earthquake load using static equivalent. Quality of the concrete used f_c' 30 MPa, the quality of plain reinforcement f_y 240 MPa and threaded reinforcement f_y 400 MPa. The thickness of slab is 15 cm form 1st floor until 7th floor, 12 cm for roof, and 20 cm for base floor. Initial structure dimensional of beam and ramp beam is 600/300 mm and initial dimension of joist beam is 500/250 mm. While for initial dimension of column are 700/700 mm. The planned base structure wearing pile foundation with depth of pile are 9 m.
Keywords: building planning, intermediate moment resisting frame, parking structure